DOE Risk Management

Volume 5, Issue 1 **Q U A R T E R L Y** **February 1997**

Letter From the Editor:

There is a huge resource of information available on the Internet creating a paperless society that saves many of our natural resources. We tell you about some of the risk-related Home Pages in this issue. Last quarter we stated that one of our goals for 1997 was to place the Risk Management Quarterly on the Internet which will make it accessible to more people and also save printing and mailing costs. Some of you may remember that a couple of previous issues are already on the Internet. You can still find them at http://necs01.dne.bnl.gov:80/html/rmq.html.

Before we can change the way we distribute the RMQ we need to hear from you. Please let us know, via E-mail or at the address below, as to whether you have Internet access. Those who do not have access to the Internet or who wish to continue to receive a hard copy can do so. Either an E-mail message or a postcard will be used to notify subscribers of when a new issue is available on the Internet.

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Inside This Edition

Modular Risk Assessment Approach Works on Large Multi-Contaminant Sites

by Alex Nazarali, Jacobs Engineering Group Inc.
Kennewick, Washington

Calculating risk to the environment from one location is typical; calculating risk from multiple past practice sites, 177 underground storage tanks, and several facilities and disposal sites scattered over a 560-square mile area is not. Screening all constituents and calculating the risk drivers is typical; determining risk for all known constituents is not. Having to add in constituents and make minor changes in the later stages of the risk assessment which requires hours of rework is typical; having a modular method to easily and quickly make changes on portions of the computations is not.

But the atypical became typical in the Tank Waste Remediation System Environmental Impact Statement (TWRS EIS) released by the U.S. Department of Energy and Washington State Department of Ecology on August 20, 1996.

New Approach Needed for Large Site with Multiple Contaminants

Because of the size and complexity of the Hanford Site, the Modular Risk Assessment (MRA) approach (Nazarali et al. 1994 and 1996, Whelan et al, 1994) was used to evaluate the risks associated with tank-related waste. As the name suggests, the MRA approach uses modules – source term, unit transport and unit risk – to estimate impact on human health and the environment.

The EIS looked at actions for 56 million gallons of waste in 177 underground storage tanks, approximately 60 active and inactive miscellaneous underground storage tanks, and 1,930 cesium and strontium capsules.

The Hanford Site was divided into 1000 meter by 1000 meter cells, and a risk calculation was determined for each cell. The source term module consisted of developing a chart of all known contaminant sources for each cell. More than 2,600 cells were needed to include the entire Hanford Site. The transport module (Whelan et al, 1995) included site-specific information (e.g. soil type, vegetation) used to compute contaminant transport through four media--air, soil, groundwater, and surface water. Established databases of unit risk factors were used in the third module (e.g. risk/Ci radionuclides). Unit risk factors (Strenge and Chamberlain 1994), are more fully described in the sidebar on page 3.

Risk was then calculated using typical risk assessment assumptions described in the Hanford Site Risk Assessment Methodology (HSRAM 1995), a consensus document developed under the Comprehensive Environmental Resource Compensation and Liability Act (CERCLA) program which combines Environmental Protection Act (EPA) and Washington State Model Toxics Control Act (MTCA) methodology.

Differences of MRA Versus Typical Risk Assessment Approaches

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Using MRA the risk assessments are more easily altered, an estimate can be done for any cell on the map, and screening of contaminants is not necessary. By using unit risk factors and unit transport factors, calculations could easily be done for each cell depending on the source term. The modular approach makes recalculating risk less cumbersome than in a typical risk assessment. If source term information was updated or challenged, the risk calculations could be easily and quickly redone without having to modify the other modules. This allowed for unusual flexibility for such a large project. Calculations could easily be redone in response to comments from decision-makers or members of the public.

In a typical risk assessment, one location identified as having the highest potential for risk is usually selected by the individual performing the assessment, and the potential receptor is placed at that location. Using the MRA approach, the TWRS EIS provided a risk calculation for all cells (~2,600) on the Hanford Site, and the public chose the receptor location. Each cell contained numerous receptor types providing a more comprehensive, aggregate picture for the exposure scenarios considered—Native Ameri-can, residential farmer, industrial workers, recreational shore line and land users. The public can place him or herself at the chosen receptor location at future times enhancing the ability to choose between cleanup alternatives.

Most risk assessments conduct a screening of contaminants to select the risk drivers. Using the MRA approach, the TWRS EIS was able to include all contaminants eliminating any question of the credibility of the screening and selection of the risk drivers.

Consequently these benefits resulted in much more information for the decision-makers and the public. Questions over which constituents are the risk drivers were eliminated; the decision-maker or the public had information about all contaminants located on the site, not just selected risk drivers. Questions about having the right receptor location were also eliminated; the member of the public could place himself or herself in any of the 2,600 cells of the Hanford Site and know the estimated risk.

Maps Greatly Enhanced Understanding of Risk

Because the risk are determined spatially and over time, the results were charted graphically on geographic information system (GIS) maps. These maps show clearly where the risks are and how the risk changes over the years. Figures 1 and 2 show the difference between two alternatives, the in situ fill and cap alternative and the ex situ intermediate separations alternative, for the residential farmer scenario 5,000 years from the present. Figures 2 and 3 show the difference in risk over time for the ex situ intermediate separations alternative for the residential farmer at both 5,000 years and 10,000 years from the present.

Members of the public were supportive of this graphic representation of risk. Commenters on the Draft EIS said the maps helped them visualize the risks for different locations.

The existing calculations and maps can be expanded to include risk calculations from other waste sites at Hanford not covered in the TWRS EIS. Additional map overlays provide a more integrated picture of risk at Hanford.

Approach Applicable to Other Sites

The modular risk approach was

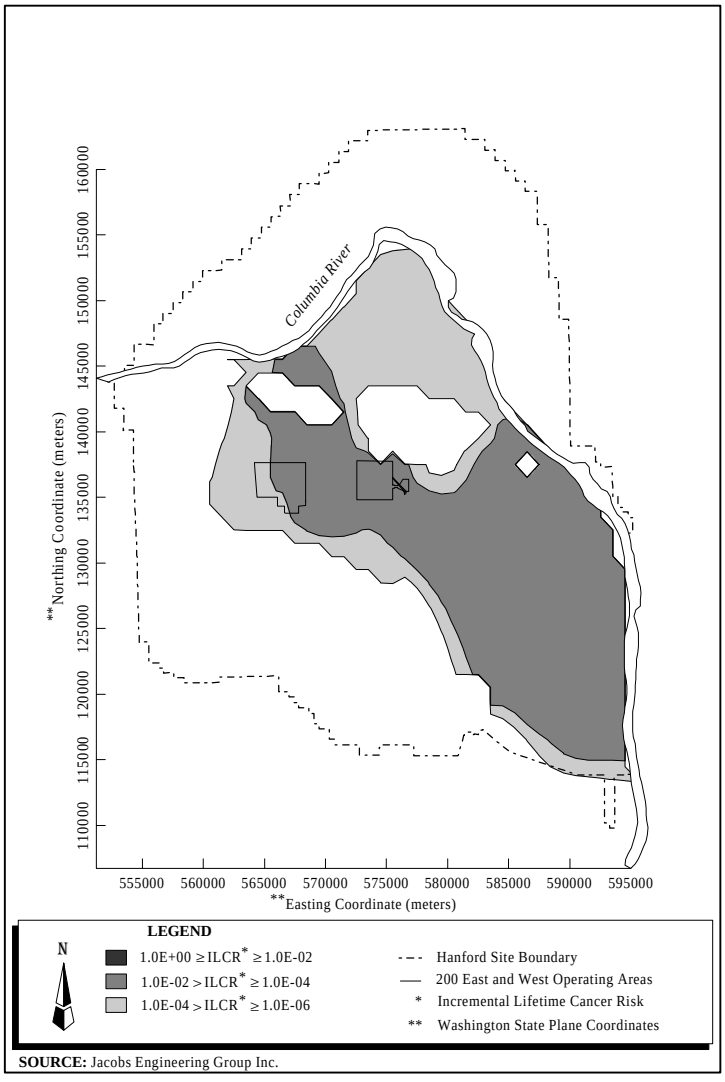

Figure 1. In Situ Fill and Cap Alternative, Residential Farmer Scenario, Post Remediation Risk from Tank Residuals at 5,000 Years from Present

designed for and is applicable to large sites with multiple contaminants. It provides a complete picture of risk from scattered and multiple sources over large tracts of land.

As with most risk assessment, the major cost and effort is in the transport module. The source terms and risk modules can be completed, updated and set aside. Linkage of the modules is done using a personal computer with an Excel or comparable program.

The comprehensive risk analysis and detailed calculations are documented in the TWRS Final EIS, available on the Internet at http://www.hanford.gov. Appendix D presents anticipated risks including: long-term individual and total land user, short-term routine, the Columbia River downriver user, and the post-remediation intruder risks. The detailed analysis of risks from accidents for occupation, operation, transportation, and commuting are presented in Appendix E, Risk from Accidents. The uncertainties regarding the risk assessment are described in Appendix K, Uncertainties Analysis.

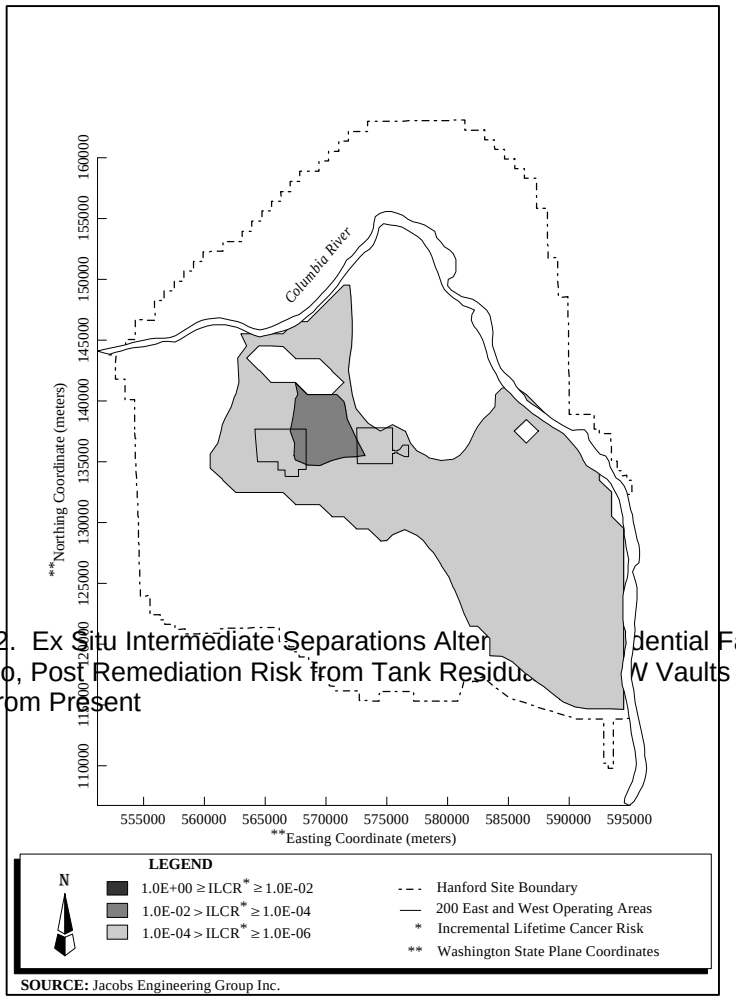

Figure 2. Ex Situ Intermediate Separations Alter dential Farmer Scenario, Post Remediation Risk from Tank Residu W Vaults at 5,000 Years from Present

Unit Risk Factors: A Component of the MRA Methodology

by Dennis Strenge, Pacific Northwest National Laboratory

The Unit Risk Factor (URF) concept was developed as a component of the Modular Risk Assessment (MRA) approach. This approach to risk assessment segments risk calculations into three primary components: source release definition, transport analysis, and exposure and risk analysis. These factors are combined to provide an estimate of the human health impact for a particular scenario. URFs are used in the exposure and risk analyses of the MRA.

The URF relates the contaminated medium concentration to predicted human health impacts for a specific exposure scenario and pollutant (chemical or radionuclide). An exposure pathway analysis is performed, per unit concentration in a medium, to estimate the potential exposure for each exposure pathway and route (ingestion, inhalation, dermal, or external radiation) in the scenario. The exposure (usually expressed as ingestion or inhalation intake) is used to estimate the human health impact. Human health impacts are expressed as cancer incidence for radionuclides and carcinogenic chemicals and as hazard indices for non-carcinogenic chemicals. Some chemicals may require evaluation of both carcinogenic and non-carcinogenic impacts. The exposure pathway analysis generates URF values for each pathway defined for the scenario, for each pollutant, and for each human health endpoint.

Exposure scenarios have been developed for use at Hanford as defined in the Hanford Site Risk Assessment Methodology (HSRAM 1995). Scenarios are defined for four land usage options: industrial, recreational, residential, and agricultural. Additional scenarios have been developed for specific applications (Napier et al. 1996) such as Native American uses for the Hanford Site, a

wildlife refuge ranger, fish hatchery workers (100-K area), and avid recreational visitors. For each scenario, exposure pathways are defined and URF values are calculated for pollutants of interest. A summary URF is often generated as the sum of the URFs for each exposure pathway defined for the scenario. The summary URFs are then a function of pollutant, scenario, and human health endpoint (cancer incidence or hazard index).

The use of URF values in risk assessments has proven very useful as the exposure and risk assessment can be separated from the source definition and transport analyses. For example, a URF generated for groundwater contamination can be applied to any location at which groundwater is a concern. In effect, the exposed individual may be "moved" to any location desired for which a groundwater transport analysis has been performed. By multiplying the calculated groundwater concentration by the URF value, an estimate of human health impacts is obtained immediately. The groundwater and source definition analyses can be modified without requiring recalculation of the exposure and risk analysis. An evaluation of URF values in support of the Hanford Remedial Action Environmental Impact Statement has been described by Strenge and Chamberlain (1994).

References (for both articles):

Duke 1995. Duke, C.S., A.M. Nazarali, and L.A. Dean. Integrated Ecological and Human Risk Assessment for the U.S. Department of Energy's Hanford site. Second World Congress of the Society of Environmental Toxicology and Chemistry. Vancouver, British Columbia. November 6-10, 1995.

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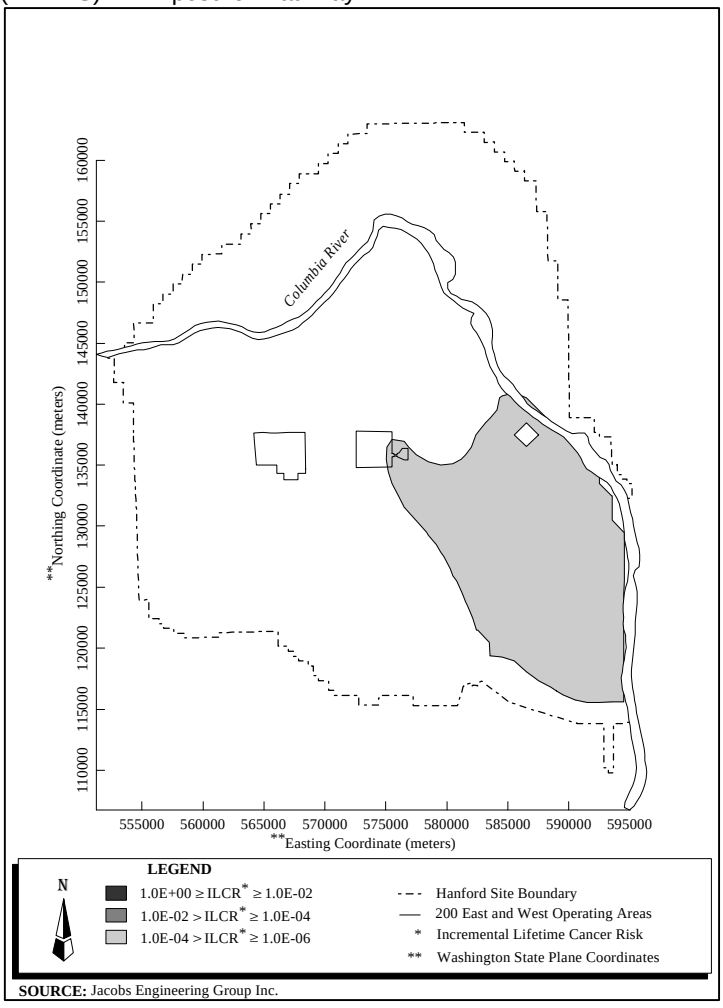

Figure 3. Ex Situ Intermediate Separations Alternative, Residential Farmer Scenario, Post Remediation Risk from Tank Residuals and LAW Vaults at 10,000 Years from Present

Reporting the Process Hazard Analysis Under 40 CFR Part 69, The RMP Rule

by Pamela J. Sutherland, Senior Scientist, Process Safety and Risk Management, Battelle-Columbus

Editor's Note: In our last issue we gave a brief summary of EPA's RMP rule. In this issue Pamela Sutherland provides a broader description of the Process Hazard Analysis portion of that rule.

On March 31, 1996, the Environmental Protection Agency (EPA) released 40 CFR Part 68 entitled, "Risk Management Programs for Chemical Accident Release Prevention." This regulation, hereafter referred to as the RMP Rule, is intended to protect the public and the environment by preventing or minimizing the consequences of catastrophic chemical accidents. It prescribes a tri-fold program of hazard assessment, accident prevention, and emergency response. One important element of the accident prevention program is the process hazard analysis (PHA), sometimes called a hazard evaluation.

The RMP Rule allows the selection of a PHA method from among several, including checklists, failure mode and effects analysis, hazard and operability studies, and fault tree analysis. For whatever PHA method is selected, however, the RMP Rule requires a team approach in applying the method to identify hazards and potential accidents associated with the manufacture and use of highly hazardous chemicals.

The hazards of a facility, process, or system must be identified to be adequately controlled. PHAs provide an organized and systematic way to identify and analyze the significance of hazards associated with processing or handling highly hazardous chemicals. The results of PHAs can assist chemical manufacturers and consumers in making decisions for improving safety and reducing the consequences of unwanted or unplanned releases of highly hazardous chemicals.

PHAs focus on equipment, instrumentation, utilities, routine and non-routine human actions, and external factors, such as severe weather, that might impact a system or process. They are directed toward analyzing potential causes and consequences of fires, explosions, releases of toxic or flammable chemicals, and major spills of highly hazardous chemicals. They assist in determining the hazards and potential failure points or failure modes of a process or system.

Complete documentation of a PHA is necessary for an organization to receive the maximum potential benefits from it. Although the documentation for a PHA will vary depending upon the method used, to meet the requirements of the RMP Rule, the documentation for every PHA must report:

❒ The members of the team that conducted the PHA, their qualifications and expertise, and the dates they participated in the PHA meetings

❒ The scope of the analysis, including the processes or systems analyzed, the types of hazards considered, and the considerations given to facility siting

❒ The PHA method used, and justification for selecting the method. The RMP Rule specifies that the method of analysis be suitable to the complexity of the process

❒ Documentation of the hazard analysis process, including assumptions, worksheets, any calculations, and analysis of human factors (basic causes of potential operator errors)

❒ The process safety information required to conduct the PHA.

The process safety information included in a PHA report consists of all of the information required to complete the analysis. To meet the requirements of the RMP Rule, it must include:

❒ A process description and process/engineering flow diagrams

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❒ Process limits and set points, and control systems information
❒ Properties and chemistry of raw materials, intermediates, products, and wastes
❒ Current piping and instrumentation diagrams, and equipment details
❒ Standard operating procedures, operations limits, and emergency procedures
❒ Reports of past accidents or incidents.

The process safety information used for a PHA can be quite extensive. It can be incorporated into the PHA report in many ways. If good document filing and management systems exist, references to specific documents may be recorded in sufficient detail that those documents can be retrieved as needed in the future. In many cases, however, it is preferable to establish a numerical file for the PHA which includes copies of all the information used in the analysis. The documents can then be referenced by number and location within the file.

Because the objective of an accident prevention program is not just to analyze for hazards, but to actually improve process or system safety, it is important that, for maximum benefit to the organization, the results of a PHA be reported in a clear, concise, and comprehensive manner. Reporting should also record the PHA in a manner that is understandable. A PHA report should allow a person who was not a member of the PHA team to understand what systems were analyzed and what needs to be done to improve the safety of those systems.

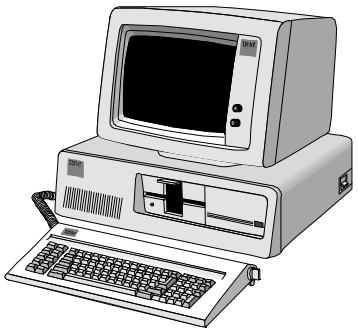
The results of a PHA are presented to management for review and evaluation, and for determination of what, if any, actions should be taken to eliminate hazards or to reduce risks through preventive or mitigative measures. In addition, because well done PHAs compile a great deal of information about the hazards of the systems or processes they analyze, if recording is comprehensive, the information they contain can be extremely valuable in process troubleshooting. PHAs can also identify opportunities for reducing operations breakdowns, improving quality, and increasing productivity.

Reference: DOE/EH-0340 ***Example Process Hazard Analysis of a Department of Energy Water Chlorination Process***, September 1993. (While not done for compliance to the RMP rule, this document provides a good example of a process hazard analysis. Readers who use this document to assist with completing a PHA for the RMP should study the differences and look for aspects that apply to the specific condition being analyzed.) RMQ

Chemical Safety Home Page at http://tis-hq.eh.doe.gov/web/chem_safety/ Great Resource!

by Lois Thiede, RMQ Editor

The new DOE Chemical Safety Program Home Page is up and running on the Internet with lots of interesting and relevant information for anyone involved in the chemical industry. Under Robert Barber, Director of the Office of Field Support (HQ DOE/EH-53), the Chemical Safety Team provides support to field activities in many areas explained in the home page. For example, in just a few minutes I was able to find and print off a copy of a Federal chemical safety regulation, an interesting article about lessons learned from the Lodi explosion of April 1996, and listings of key people and organizations in the government and private sectors including the American Institute of Chemical Engineers and the Chemical Manufacturer's Association.



The Home Page includes very useful sections on What's New, DOE Documents, Chemical Occurrences, Chemical Safety Networking, Chemical Safety Tools, Other Chemical Information Links, and Questions & Feedback. New in April, the Risk Management Quarterly will appear in a section of this home page. It's very easy to move around the Page and find the information you want. Pictures and graphics enhance many of the sections.

Under the direction of Ken Murphy, the Chemical Safety Team Leader, the new Home Page was started in December of 1996. "We had 7,500 visitors to our Home Page in January," says Dr. George Schlossnagle, Chemical Safety team member who regularly coordinates and updates the information on the home page. "So far most of our visitors seem to be from outside DOE, including many contacts from universities. We're here to serve all DOE customers in the private and government sectors."

Submittal of articles for **the *Risk Management Quarterly is*** encouraged. We can best provide a variety of interesting articles if they are submitted by the practitioners of risk assessment and risk management. Articles can be mailed, faxed or E-mailed to Lane Environmental, Inc. at 2000 Logston Boulevard, Richland, WA 99352
Phone: 509-375-3268, ext. 133
Fax: 509-375-0143
Articles should be 800-1200 words in length and include one or two figures to accompany the text. Articles should be cleared locally as needed before submittal. The RMQ Editors will make the final decision on which articles to print.

Upcoming Articles:
❒ Recycling Steel from DOE and NRC Facilities
❒ 10 CFR 834 Rule
❒ EcoSim - an ecological risk assessment board game

The Home Page can be found at http://tis-hq.eh.doe.gov/web/chem_safety/. It was started to assist DOE field activities with finding information on chemical safety and chemical process safety. The home page continues to build upon relationships already established between DOE and the Chemical Manufacturer's Association (CMA). Relationships with the CMA and the Center for Chemical Process Safety (CCSP) were established to facilitate an exchange of environmental health and safety information between the government and industry.

The future direction of the Home Page is being defined as it gets underway and customer needs are better understood. Says Dr. George Schlossnagle, "It's fun to see who visits our Page and what their real needs are. We really want our customers to provide suggestions to improve the home page and give us feedback on their real needs. We encourage visitors to give us their thoughts in the Questions & Feedback section. We update the Page at least every other week, so we can include very timely information and be responsive to customer suggestions."
Check out the Chemical Safety Home Page for yourself and let Ken and George know what you think of it. George can also be reached by phone at 301-903-9418 or via Email at george.schlossnagle@eh.doe.gov.
Try:
http://tis-hq.eh.doe.gov/web/chem_safety/

Let us know at Lane Environmental, Inc. if you can't visit the home page.
RMQ

Other Risk-Related Internet Addresses

Many government agencies have information on the Internet. In addition to the Chemical Safety Home Page, you can access other U.S. Department of Energy home pages by going to:
http://www.doe.gov
At that location you can find information about the department through sections like departmental resources or news and hot topics. Through a section entitled, People, Places and Organizations , you can go to a specific DOE headquarters or program office, such as EH or EM, one of the operations offices, any of the DOE laboratories, or other field facilities.

Other government sites can also provide health and safety information relevant to risk-related projects. These are two such sites:
http:///www.osha.gov
http:///www.dol.gov
Again, these home pages will lead you to other home pages with more specific information.

And don't forget these previously provided addresses for CRESP:
http://www.eohsi.rutgers.edu/cresp/cresp.html
http://weber.u.washington.edu~cresp/realindex.html

Below are several other sites that may be of interest to people involved in risk assessment and risk management:

Title: Reporting on Risk: A Journalist's Handbook on Environmental Risk Assessment
Author: Foundation for American Communications and National Sea Grant College Program
http://www.facnet.org/report_tools/guides_primers/risk/main.html
Description: Contains a useful guide on the basics of risk assessment, exposure assessment, toxicity assessment, epidemiology and more.

Title: Risk Management Information For Those Just Getting Started
Author: Public Risk Management Association - Nevada Chapter
http://www.greatbasin.net:80~/nvprima/basic.htm
Description: A good introduction to the essentials of risk management.

Title: Environment, Health and Safety *Risk Analysis and Risk Management* on the World Wide Web
Author: Ionna Papadakis
http://.seas.upenn.edu:80/~papadaki/riskanal.htm.
Description: Contains information on how risk analysis is viewed by people, information on various risk associations, research, consulting firms and provides other links to web sites with the same risk management theme.

Title: Environmental Impact Assessment: Resources List
Author: Eldis - hosted by the British Library for Development Studies
http://www.ids.ac.uk/eldis/envimp/eia_lele.html
Description: Provides a list of web site links that provides useful information on environmental assessments.

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